

21

A HIGHER INDUSTRIAL AND COMMERCIAL
EDUCATION AS AN ESSENTIAL CONDITION
OF OUR FUTURE MATERIAL PROSPERITY.

AN ADDRESS

BEFORE THE

Society for the Promotion of Engineering
Education.

BY

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PRESIDENT OF THE SOCIETY.

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PRESIDENT'S ADDRESS: A HIGHER INDUSTRIAL AND COMMERCIAL EDUCATION AS AN ESSENTIAL CONDITION OF OUR FUTURE MATERIAL PROSPERITY.

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PREFACE.

In thanking you for the honor you have conferred upon me in selecting me to preside over your councils at this our sixth annual meeting, I wish to give some expression to the feeling of responsibility I have always felt as a member of this Society. I believe the manufacturing and commercial prosperity of our country is directly dependent upon the technical education of our people, and so far as this Society has taken upon itself the shaping and the development of this education, so far are we, as members of this body, responsible for the results attained. This feeling will explain, also, my choice of a subject for this address.

While the material prosperity of any country is not the ultimate highest good, it is the foundation of the happiness and of the progressive enlightenment of its people. To learn the essential conditions of such a prosperity, therefore, is a matter of supreme importance. I invite your attention to-day to what I conceive to be one of these essential conditions. So far as these conditions consist of educational opportunities and advantages, so far they are properly presented to, and considered by, this Society, which now very

largely directs the present methods and will direct the future policy of the technical instruction in America. In approaching this subject we are at once impressed with the conviction that the teachings of history are not available to serve as a guide in this matter.

We are living in a new world; old things are done away, and all things have become new. In the former times all knowledge of material things was traditional and had to be learned by the traditional methods; to-day nearly all such knowledge is scientific, and should be acquired by scientific methods. Formerly the industries were directed by mechanics who, by a long apprenticeship, had slowly acquired the manual methods of their predecessors; to-day they are most successfully guided by men of large scientific attainments; and in the near future such scientific direction will be absolutely essential wherever there is free competition in the market to be supplied. Prosperity, or even supremacy, in material things in the past, is therefore no promise of such a position in the future, and as a proof of this we have but to compare the past achievements of England and its present subordination to Germany.

PAST COMMERCIAL SUPREMACY OF ENGLAND.

For the past three hundred years England has labored systematically to encourage all her sources of material prosperity.* By special charters to commercial and manufacturing companies; by minutely elaborate laws governing apprentices, their terms of employment,

* See Cunningham's *Growth of English Industry and Commerce*, 1892.

and their wages; by high and often exclusive protective tariffs; by subsidies and by exclusive trading privileges granted to navigation companies; by the importation of skilled workmen from Holland; by receiving the Huguenot refugees from France, and by the prevention of the emigration of skilled mechanics; by her coal and iron deposits; by her early development of the steam engine and its application to the various industries, including railroads and steamships; by the industrious habits and the aggressive disposition of her people; by her honesty in governmental and business relations; by parliamentary commissions without number, and with a continuous and consistent policy on the part of the whole people of England, she succeeded finally in absorbing most of the manufacturing and in carrying nearly all of the commerce of the world.

Holland's commercial supremacy disappeared with the loss of her navies by war, and the one-time industrial supremacy of France always lacked the necessary shipping to bring her products to the four corners of the globe as England has been able to do. Finally, by adopting a free-trade policy, when her interests were mostly centered in foreign countries, her manufacturing industries obtained such an impetus that it seemed England would long remain the leading manufacturing country of the world. In this conviction her people have placidly followed in the footsteps of their fathers well assured that nothing could shake the commercial, Gibraltar which they had cause to regard as a natural inheritance.

SUDDEN RISE OF GERMAN COMPETITION.

But behold the great awakening! Across the channel a score of small kingdoms of like ancestry had been slowly preparing for the most astonishing things. In the throes of the Franco-Prussian war a great nation experienced a new birth, leading to such a series of material achievements as the world has never witnessed before. Within twelve years of the date of this new birth a Royal Commission from England, after a most careful study of the situation, reported that England had everything to fear and many things to learn from her new rival. The situation grows annually more acute and to-day England finds herself about to lose her position forever as the leading manufacturing and commercial nation of Europe. The explanation of this remarkable transition is deserving of the most careful study and it is of peculiar interest to the members of this Society. That an interior country like Germany, without a navy, and with little foreign commerce, could in a quarter of a century increase her manufacturing capacity ten-fold and make it equal to that of England;* increase her shipping twenty-fold, making it second to that of England; effectually establish a regular export trade with every country on the globe, and by at once cheapening products and improving their quality put herself in a position to hold these markets indefinitely; that all this could be accomplished in the face of open competition and in this age of universal publicity, is

* See Mulhall's *Industries and Wealth of Nations*, 1896.

indeed marvelous and would alone prove that old methods have lost their potency and that something new has arisen under the sun.

CAUSE OF GERMAN PROSPERITY.

When we seek an explanation of these wonderful achievements we find only a rational and provident application of means to ends, but on the most gigantic scale, and persevered in far more consistently than has ever before been even planned, to say nothing of execution. It is evident enough that no art or science can be known until it has been learned, and to learn most rapidly and thoroughly one must be taught. For the past forty years Germany has been systematically teaching her people in every kind of commercial and industrial employment. These people are no brighter, have no more receptive minds or more skillful hands than the people of the Anglo-Saxon races. There are in England to-day millions of men and women naturally as capable and as desirous of employment as these thrifty and toiling Germans, *but they are left without competent expert direction.*

We say Germany has a paternal government, and one entirely unsuited to the independent spirit of the Anglo-Saxon people, but if we allow ourselves to be blinded by this argument we make, I believe, a tremendous and fatal mistake. When industrial capacity rested wholly upon traditional and empirical knowledge and upon manual skill it was absolutely essential that artisans should obtain all this knowledge and skill as apprentices in

the shops and mills as manual helpers and as unintelligent copyists. But since nearly all processes of the artisan have now a scientific and rational basis, and the work is done by machines which are the embodiment of the highest type of human reason and understanding, and since the machines require an almost equally intelligent oversight and direction to produce their largest output, and furthermore, since the new discoveries of science require continued changes in materials and methods to keep abreast of the times and to hold the market, and entirely new industries are daily established founded on some new discovery or invention, and since the demand no longer determines the supply but new and improved supplies are constantly creating their own demands in all lines of industry, *it is evident that the efficient direction of any industry to-day demands a very large amount of technical knowledge which can not be learned at the bench or in the shops.*

While self-education is always possible, the obstacles are commonly prohibitive, and at best the results are meager and unsatisfactory. There is no more costly luxury than an inventive but ignorant superintendent. Germany has seen this situation most clearly and it is her clear perception of this problem and her rational and thorough solution of it that has raised her industrially from poverty and obscurity to wealth and fame in the short period of a quarter of a century.

THE NEW CONDITIONS OF PRODUCTION.

Germany was the first to perceive that by the application of steam power to industrial production the capacity for such production by a single country is almost unlimited. Thus any one of the leading industrial nations could easily produce enough of the more readily transported products to supply the entire world, and the amount any one nation will succeed in supplying depends wholly on its relatively superior knowledge, and on its facilities for manufacture and sale. The material prosperity of any country in the immediate future, therefore, will be determined far more by the intelligent direction given to its industrial pursuits than by either its natural advantages in raw materials and transportation facilities, or on its past achievements in any particular direction. The constant cheapening of the cost of production of manufactured articles by science and invention dwarfs into insignificance the apparent advantages of geographical position. The practical obliteration of time and space by the speed and economy of modern transportation facilities has caused the earth to shrink and shrivel to dimensions far smaller, relatively, than those of the Roman Empire in its palmy days. It is a small matter to-day for a single firm to do business in every civilized country on the globe. With the helps which the telegraph, the type-writer, and the telephone have brought into every business office, one man does the work of a dozen, so that the mechanical increase of production applies to the business office as well as

to the shop. In the meantime the common people the world over are approaching one type of manners and customs, their aesthetic tastes are developing and their wants are indefinitely multiplying. Here again the improved supply is creating the demand and the more this supply is made to conform to the growing refined and artistic tastes of the people, the greater becomes its demand. The highest artistic talents of the best industrial artists are in constant demand in Germany, designing new and attractive patterns of form and color and texture to meet this rapidly developing taste of the common people.* And it is the common people who must be considered in manufacturing. These compose the great bulk of society and fix the demand for the great staples of production.

THE GERMAN MONO-TECHNIC SCHOOLS.

Seeing, therefore, that the capacity for production is limited only by the intelligence and foresight of a people, and that there is a rapidly growing and prospectively unlimited demand for all kinds of artistically manufactured goods, Germany set to work some forty years ago to supply this demand by the intelligently directed labors of her own people. This had long been the home of classical and military learning, but it now became also the very center and head of technical and industrial education. The members of this Society are all quite familiar with her high-grade

*The city of Berlin alone manufactures and sells in England over five million dollars worth of ladies' mantles annually! *Rep. of Tech. Instr. Com. of Manchester, Eng.*, 1897, p. 7.

engineering schools, but we are not so familiar with her industrial schools. In fact we have commonly spoken of these with more or less indifference, calling them *trade-schools*. We have assumed that the difference between them and the engineering schools was one of kind, rather than quality or degree. As a result of some recent study of the leading industrial schools in Germany, I am inclined to question the justice of our position. Since the sciences of mathematics, of physics, of electricity, of chemistry, of mechanics, of steam engineering, and of the materials employed, enter so largely into all these school courses, they are in fact schools of applied science and they now pass in Germany under the very appropriate name of "Monotechnic" schools.* Such schools are there found for all the leading industries of the empire, and there are many schools for the same industry. Thus there are in Germany thirteen schools devoted to the textile industries, each with its peculiar organization specifically adapted to the region in which it is placed. As little duplication as possible is practiced and when the same field is covered in two or more schools, variations in methods are introduced for the purpose of comparing results. The students entering these schools have first to complete the course of study in their secondary scientific schools (or say through the sophomore year of our engineering schools), and then the course of study in the mono-technic schools is three years, of

*See *Report of the Technical Instruction Committee*, city of Manchester, England, 1897.

forty-five hours a week, on the successful completion of which certificates are granted.

The fine and costly buildings in which these schools are installed; their elaborate equipment, with all the needful chemical and physical laboratories, and all the machinery required to convert them into regular commercial factories; their large corps of trained teachers and the very small number of students admitted to take their full courses; the administrative care and oversight given to them, and their very small tuition fees, all serve to make the training given in them extraordinarily expensive to the state. Thus the textile schools of Crefield had last year only one hundred and eight regular day students in the weaving school and forty in the dyeing and finishing school. In the weaving school was the director with fifteen assistant lecturers and six other assistants; in the dyeing and finishing school there were the director and three assistant lecturers, a special chemist for dyeing and one for finishing, or a force of twenty-nine instructors for one hundred and forty-eight regular students. There were, however, irregular students in attendance on night and Sunday courses. The plant of this school included extended chemical and physical laboratories fully equipped, drawing rooms, lecture and testing rooms, chemical museum, library, and reading rooms. *The mechanical equipment was that of a complete weaving, dyeing, and finishing works for all the finer grades of cotton, linen, woollen, and silk goods.* Commercial work is done on a large scale, the students

doing the work under the direction of the assistants. Specially difficult tasks in dyeing are here undertaken and successfully accomplished, and regular consignments of this character are made by some of the leading factories of the empire.

This school is only one of hundreds in Germany which are training up a class of men for the *direction* of all kinds of industrial works in which scientific knowledge is finding its embodiment and application. As a result of this training we find such great industries as the aniline and soda works at Ludwigshafen on the Rhine, which has grown from employing a total force in 1865 of thirty people, to employing five thousand men and over a hundred trained chemists in 1897; also the optical and electrical works of Schuckert & Co., of Nuremberg, which started on a very small scale in 1882 but which now employs over four thousand men besides a large scientific staff, and which had in 1897 unexecuted orders on hand aggregating \$15,000,000. Three fourths of all the coloring matters and pharmaceutical products now produced from coal tar are made in Germany, their total annual products are this class aggregating \$40,000,000. The earliest chemical discoveries of these products were made in England, but there was not sufficient knowledge of applied chemistry in that country to utilize the discoveries.* It is such examples as these, of which there are many, that indicate that Germany is reaping the fruits of the painstaking and far-seeing policy she has entered

**Report of Technical Instruction Committee, City of Manchester, England, 1897, p. 12.*

upon; and if other nations wish to share her prosperity they must act with a like wisdom and determination. The proof that Germany's remarkable industrial prosperity is traceable very largely to her educational methods* is not only granted by all foreigners who have investigated the matter, but it is so patent to the people themselves that they voluntarily unite to support schools for apprentices in their particular trades. Thus of the 248 mono-technic schools in Prussia alone which are so supported, the painters and decorators have 32, the shoemakers 9, the tailors 16, the bakers 20, the butchers 6, the smiths 26, and so on.

Every trade has its own schools, aside from those supported by the state and by the municipalities. The artisans themselves see that systematic and scientific teaching entirely outclasses the old apprenticeship system, and these schools are constantly multiplying. In Saxony alone there are three of these mono-technic schools, besides ten schools of agriculture and forty of commerce. In the Grand Duchy of Hesse, with a million inhabitants, there are schools of agriculture and sculpture, nine schools for artisans, forty-three for industries, and eighty-two schools of design. The Grand Duchy of Baden with 1,600,000 inhabitants supports schools of industry, architecture, commerce, clock-making, cabinet work and music, with an annual expenditure of \$280,000. In addition to these schools peripatetic teachers are employed to go from house to

†See *English Consular Report* No. 2046, entitled *Trade in Germany*, April, 1898. Also the remarkable work of J. Scott Russell, entitled *Systematic Technical Education for the English People*, 1869.

house to instruct in embroidery and in the use of the sewing machine, the state selling these machines at a greatly reduced cost on condition that the purchaser shall explain its workings to her neighbors. In fact Germany, as viewed from without, would seem to be in the throes of a kind of educational fever. No doubt a large part of this educational work has been necessary as a result of the very backward condition of the common people along these lines, and to such an extent these methods could not find a place in this country; but aside and beyond these limits may we not see in the example of Germany the royal road to industrial prosperity? While the industrious character of the people; the military spirit which pervades all her industrial and commercial affairs, as well as the military and state departments; the absolute stability of her governmental policy and the fixedness of her currency and of her financial system; and the disposition to be satisfied with small wages and profits so long as these both rest on a sure and permanent footing—while all these certainly contribute largely to her present material prosperity, these same advantages are also held with her in common by some other countries which are not, however, sharing her present prosperity. The tremendous military budget of Germany cuts deeply into her productive profits, so that without this her commercial advancement would have been still more marked. It is not her army of soldiers, however, which other nations need to fear, *but her army of scientifically trained directors of industrial enter-*

prises and of the highly educated commercial agents at which they may well tremble.

THE COLLEGES OF COMMERCE.

For they not only educate the men who manufacture, but they are also beginning to look well to the training of the men who are to carry their goods to the ends of the earth and report the peculiar needs of every locality. Schools of commerce are being organized, modeled after those of France and Belgium, in which in addition to what is taught in our "commercial colleges" will be found a speaking and writing acquaintance with several foreign languages, especially English, Spanish, and French, if these have not already been acquired; political economy, industrial, tariff, and patent laws; railroading, shipping, postal and telegraph regulations; banking, exchange, coinage and national schemes of finance; industrial history, commercial geography, etc. A German national conference was held on this subject a year ago and a new system of commercial education is now being established all over the empire. Modern languages form a part of the elementary school training, especially English, so that the entering students in these schools are likely to be well equipped in this particular. With such material as these schools will turn out, their students coming from the better mercantile classes and having the manners and bearing of gentlemen, the large manufacturing and mercantile houses can establish branches in all the leading foreign countries, and with the system of foreign German

banks which are even now found everywhere, the conditions are ripe for the ready and rapid sale of German products in all parts of the world.

From a remarkable publication by Mr. Frederick Emory, just issued from the Bureau of Foreign Commerce of our State Department, on the recent increase in our foreign trade and in reference to the necessity for the individual manufacturer and the merchant to study carefully the trade conditions in foreign countries, I quote:

“Nor is it with the relation of the different nations to one another that we are alone concerned. The industrial changes current within the territory of each obtain a new and much graver importance in their possible effect upon our nascent development as an exporter of manufactured goods. The conditions contributing to the rapid growth of manufacturers in recent years; the fiscal changes in Russia, India, and Japan, as well as in some of the Latin-American countries; the extraordinary impulse given to the industrial growth of the German Empire as a factor of international trade; the advance of Russia on similar lines; the rapid progress of the Siberian railroads toward an open port on the Yellow Sea; the efforts of Great Britain to meet the encroachments of other nations; the decline of the sugar industry in the West Indies as a result of the beet-sugar competition; the troubles of Spain with her colonies; the discovery of gold in Alaska and the adjacent territories in British Columbia; the tariff legislation of the United States, Canada, and other countries; all the phases of economic changes during the past year have an interest and importance for the individual operative in the United States which are greatly enhanced by the transformation now going on in our industrial life, converting us slowly but surely from a people absorbed with the internal development of a virgin continent into one of the great commercial powers of the world, with the international interests

and responsibilities which such a position naturally implies.”

Evidently, in order to keep abreast of all such changes, which are constantly going on the world over, a special class of highly trained men is required. And here, too, the supply of such a new and improved kind of clerical assistance would at once create its own demand. It would seem the time is now ripe in this country for the establishment of such schools. They are needed as much or more for the training of our foreign consuls, as for the commercial agents of our large business houses and industrial establishments.*

In France there are eleven of these high-grade colleges of commerce.†

The course of study is two years, with a preparatory year, all of thirty-three lecture hours a week. The following is a brief outline of the distribution of this time, the minimum age being sixteen years, which is predicated upon a preparation about equal to our college entrance requirements to which has been added in the preparatory year about all that is taught in our American so-called Commercial Colleges:

DISTRIBUTION OF TIME IN THE FRENCH COLLEGES OF
COMMERCE.—(Time two years.)

Eleven hours per week to Commercial Methods and Transactions in what is called the commercial bureau.

Three hours to Commercial Geography.

One hour to the History of Commerce.

*See an article by Senator White, on *Our Inadequate Consular Service* in *The Forum* for July, 1898.

†For a full description of these and also of those of Belgium, as well as a complete exposition and analysis of the entire system of English Technical Education, see *Proceedings of the International Congress on Technical Education*, held in London, June, 1897, under the auspices of the Society of Arts. See, also, Prof. James' *Report to the American Banker's Ass'n on The Education of Business Men in Europe*.

Two hours to a study of Commercial Products, involving the actual handling of the materials.

Two hours to Commercial Law, maritime and industrial.

One hour to Political Economy.

One hour to Type-writing.

Four hours to a speaking and writing knowledge of English.

Four hours to a speaking and writing knowledge of some other language; as German, Spanish, Italian, or Arabic.

Three hours to some special course in Chemistry, Transportation, Microscopy, Commercial Technology, or Stenography.

THE LESSONS FOR AMERICANS TO LEARN.

But you may say, what is all this to us? Have we not the finest system of public schools in the world? Have we not any number of Manual Training Schools and numerous Pratt and Armour Institutes? And, finally, have we not a great many engineering schools as good as the best, even in Germany? And have we not "Commercial Colleges" without number?

Suppose that I grant all this, may I not still say that the common schools give no special preparation for any kind of employment; that the manual training schools likewise fit for nothing in particular; that our engineering schools fit for very narrow lines of professional employment and commonly educate men away from the industrial pursuits rather than towards them; and as for our so-called commercial colleges, what do they teach beyond arithmetic, book-keeping, stenography, and type-writing? Where then does the specific scientific training for the manufacturing and commer-

cial industries come in? I submit that it does not come in at all; that our factories and business houses are largely managed by men of little or no scientific training, who have learned their crafts in the traditional way; who are, however, of an inventive turn of mind and who read the trade journals. They are a great credit to the system that has produced them, and many of them have become self-educated into an excellent state of efficiency; but as a class they are far from the ideal directors of such business, and very far indeed from the standard already achieved in Germany. Their success can in most cases be attributed to the extraordinary conditions offered by a new and rapidly developing country rather than to any superior ability on their part. Our largest iron and steel industries and our metallurgical and electrical works are now well-directed by scientific men, but even these have not the properly trained agents to exploit their wares abroad.

Again you ask if we are not now the greatest manufacturing nation of the world, and are we not sending many of our manufactured products to all the countries of the old world? It is true that this is the case, and yet I am not very confident that this is a promise of that great material prosperity which this country should enjoy. It has been well said that *America* is but another name for *opportunity*. This is certainly true. Never before in the history of the world has man had such fabulous opportunities for material good as we have had given to us in this glorious land. Nowhere else on the face of the globe is

there such a land. With a soil of exhaustless fertility if properly cultivated; with original forest resources sufficient to supply the world for centuries; with an infinite energy stored in our ample coal beds, and in our oil and gas deposits, which are almost co-extensive with our territorial limits; with the richest iron ores so plentiful and abundant as to make their value scarcely more than common rock or earth; with copper, lead, zinc, gold, and silver deposits in marvelous quantities; with a climate all that could be desired and nowhere equaled for agricultural purposes; and finally, but most of all, peopled by the most progressive races under the sun; with all these infinite opportunities, surely something should have been accomplished. And because much has been accomplished we are prone to attribute our unprecedented progress to our own superior wisdom, and so we are being consumed by our own egotism. As a partial correction to this tendency let us glance for a moment at some of the unworthy and foolish things we have done, in order to bring ourselves into a more teachable mental attitude.

We have exhausted a large portion of our lands by spendthrift and improvident agricultural methods, and have moved on to the next new country to repeat the process until we have reached our uttermost bounds and have been turned back by the inhospitable mountains and desert plains; we have squandered our forest resources and are even now seeking timber supplies from our northern neighbors; we have wasted our natural gas supplies in a most foolish and prodigal

manner; we have enslaved an inferior race and then quarreled over them at the cost of half a million of lives, and thousands of millions of dollars; we have foolishly trifled with our finances and with our civil and consular services, in a way to bring upon us the contempt and loss of confidence of all honest and intelligent nations; we have built railroads enough to girdle the globe many times, and have persuaded foreign capitalists to loan money on them to many times their cost and to far beyond their productive capacity to pay; we have allowed our shipping to dwindle and die and are sending out all our exports and receiving our imports in foreign vessels, and by such lines as suit their own interests; we have given away our municipal franchises to favorites, or for pelf, and so put upon our people burdens of taxation which should have been paid by the profits which now find their way to the coffers of our multi-millionaires, of which all our large cities are able to boast; we have allowed our voters to be corrupted by our special legislation, by our wholesale pension lists, and by our covert bribery at national elections, until the feeling of patriotism with all its altruistic accompaniments has largely given place to the party query, "what is there in it for me?" We have acknowledged our inability to govern our large cities, and they are turned over to hungry hordes of self-seeking and dishonest ward-committeemen, who serve only the party boss; even in the face of a foreign foe we have subordinated military to political rule, trusting in the weakness and greater

blundering on the part of our enemy rather than to a studied fitness of men and means for the successful prosecution of a righteous war; in short, are we not running the race of the prodigal son, and should we not now come to ourselves and ask if there are not better methods of administering our heritage to be learned in our father's, or, as I am insisting to-day, in our grandfather's house? Any spendthrift appears to prosper as long as the money holds out; our inheritance from nature was so bountiful it is holding out well; but we are spending and wasting it as rapidly as possible, and we are beginning to find ourselves cramped to maintain our unwise and extravagant courses. In fact, for the past five years, we have suffered greatly and have not known what was the cause of our distress. Our manufacturing industries have been greatly depressed, while those of foreign countries have been experiencing a period of unwonted prosperity. Six million of our voters have said, in effect, our distress is the direct result of our neglect of the worship of their silver idol and of worshiping instead a golden calf. Various quacks have prescribed for our debility, but in my humble opinion the seat of the trouble has been in the head. We are reaping the legitimate fruits of our own foolish sowing. We sowed the wind and have reaped a whirlwind. We have ignored and scouted all the established laws of material prosperity, saying they did not apply to this country, and after five years of punishment for our sins of ignorance we are still shutting our eyes to the plain teachings of our sorry experience.

But this address was not intended to cover the whole category of national ills; it was to be limited to the prime essential conditions of our material prosperity in the immediate future. In the first making of a country the industrial demands are so great that the ordinary laws of trade and commerce do not apply; but now our country is fairly well developed, and we are practically on a par with the countries of Europe so far as our manufacturing industries are concerned. We can supply far more than our own demands, and the profitable marketing of this surplus will soon mark the difference between prosperity and adversity. We are now relying largely upon our boasted ingenuity, and of this we well may boast; but in the future nearly all the profitable inventions will involve a large amount of scientific knowledge on the part of the inventor. In fact, our technical schools claim to train men to become inventors, and this is indeed true. Inventors, hereafter, will be made, not born; the born but untrained inventor is daily becoming more dangerous and will soon be avoided as a calamity.

CONCLUSION.

The most essential condition of our future material prosperity, therefore, is as I conceive it, *a specific scientific training for the directors of each and every kind of manufacturing and commercial activity.* This is the burden of my address; the imperial and paternal government of Germany has worked out this problem to a most fruitful issue, but probably no other country could duplicate it. England has been trying

for ten years to do so, but with very poor success; instead of highly educating a few leaders and directors of industry and commerce, they are vainly trying, at an expense of some five million dollars a year, to raise their entire class of apprentices and clerks by a whole-sale system of shallow night-school instruction. Apparently a duplication of the imperial German system is not to be thought of in this union of forty-five independent states. The great question for us to solve is how to obtain a corresponding specific training for our industrial officials. The problem is a difficult one; to expect that our American municipalities would engage in such a rational expenditure of funds is beyond our credulity or hope. Our state legislatures are not likely to realize this need so fully as to inaugurate and to consistently support a series of such schools. The National Government now pays out of the United States treasury directly to the several state agricultural colleges one million dollars a year, and I fear without adequate returns. If this amount or more could be annually devoted to paying the salaries and superintending the instruction in a properly administered series of mono-technic schools would not the primary purpose of these schools be more fully met? This purpose is defined in the original act of Congress in 1862, to be "to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life." The first cost of any new buildings and equipment required could certainly be secured by local state, municipal, or voluntary aid. To insure a proper

coordination, rather than duplication, of their work, these schools should be controlled by boards, in all of which the United States government should be represented.

It is true that some beginnings have been made toward the inauguration of such high grade industrial and commercial schools as are here contemplated. At the State University of Ohio, in conjunction with the National Brick Manufacturers' Association, a special course of study has been put in operation covering the clay industries, but not including ceramics and cement manufacture. In the city of Philadelphia we have a school of industrial art, started under private auspices but now under the patronage of the state, which is said to rank with the best industrial schools abroad, especially in its textile department. At the Universities of Pennsylvania and Chicago the studies in political and social science have been given a commercial application, and a few of our largest cities are also making a start toward the establishment of commercial high schools. It is well known that our mechanical, electrical and mining schools fairly cover the theory and some laboratory practice of our various mechanical, electrical, and metallurgical works, and this schooling is usually supplemented by tours of inspection to large typical works. So far as the graduates of these schools engage in the manufacturing industries they serve the purposes herein contemplated, but they are entirely inadequate to answer the general demands of a manufacturing and commercial people, and it is evident that we

have not yet set ourselves earnestly to solve this problem.

It is probable that our organized commercial bodies offer the most favorable auspices for the inauguration of these mono-technic and high-grade commercial schools. The problem is, however, not without its difficulties, and before anything is done, or even recommended, the whole question should be examined and reported upon by a joint commission of educators, manufacturers, and business men appointed preferably by the national government. Our government has already made a beginning in this direction. Seven years ago an appropriation of five thousand dollars was made by Congress, to be spent by the Labor Commissioner, in reporting upon the methods of technical education practiced at home and abroad. Mr. Wright brought out a very full report on this subject in 1893, which may still be studied with profit. As this kind of education is so foreign to the spirit and methods of all forms of general or culture education it would seem to demand also a separate bureau for its administration, and this we should have to have if anything of consequence is accomplished.

And now, as a conclusion of the whole matter, should not this Society take the initiative in these movements? I believe it should, and I believe the future material prosperity of this country is very largely dependent on how these problems are solved. Let us remember that we can no longer judge of the future by the past; to-day both the successful manufacture

and the sale of goods are reduced to exact sciences. Old things are done away and all things have become new. Let us see to it that our ship of state shall be guided by the lights which are now so successfully leading others through the channels of progress, rather than to continue to steer by the vanishing lights of a tortuous past which may eventually land us on the sandy banks of delusion and improvidence.